Gas Journal

295. 110th YEAR. LONDON, JULY 23, 1958 No. 4958 PRICE 1/6

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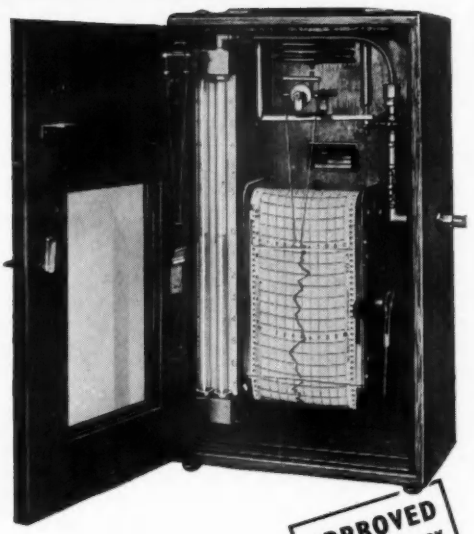

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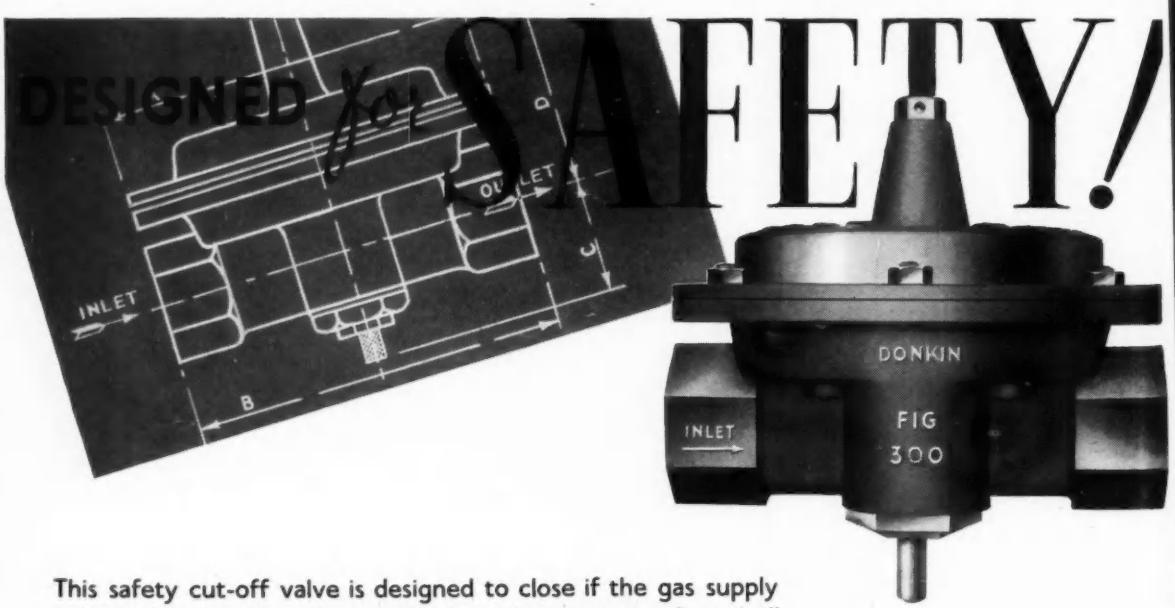


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# Gas Journal

VOL. 295 NO. 4958 23 JULY, 1958

110TH YEAR

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# Gas Journal

VOLUME 295. No. 4958 JULY 23, 1958. 110th YEAR


## *Coal and the Crisis*

OUR basic fuel sources have been much in the news during the past week or so. In the forefront looms the critical situation in Iraq, which leads one to wonder how far the remarkable flexibility displayed by the oil industry during the Suez crisis could be extended in the event of widening unrest in the Middle East. And we must not forget that oil consumption continues to rise sharply (oil deliveries for internal consumption rose by over 30% in the first half of the year). It is worth remembering that the largest single item in this growth consists of bigger deliveries to electric power stations, yet another example of how this increased fuel oil consumption is occurring at the expense of other fuels, principally coal. Competition apart it has been pointed out that a healthy coal industry is the securest form of national insurance against being held to ransom by fuel suppliers anywhere. That being so it would be reassuring if we could regard the coal industry as an 'old faithful' on whom reliance can always be placed in a crisis. Alas it is not so, for it seems that every week brings fresh evidence of labour difficulties and N.C.B. policies the wisdom of which are, to say the least, questionable.

As we suggested in an editorial a few weeks ago, the coal industry is in a highly critical condition. Except in the case of large coal, demand is now generally below the level of supply, and the cost of financing the greatly increased unsold stocks is contributing to the industry's difficulties. Production in the first six months of this year was 5 mill. tons, or nearly 5% below the corresponding period last year; according to Sir James Bowman, the N.C.B. Chairman, home demand this year might be 12 mill. tons below that in 1956. The only bright spot is the fact that the output of large coals seems to have stopped falling—a comforting thought for many in view of the derationing of house coal.

To a large extent the N.C.B. is at the mercy of its labour force which as yet shows little sign of realising that the economic wind has changed. The response to a falling market for coal, as interpreted by Mr. Ernest Jones in his presidential address to the conference of the National Union of Mine Workers at Porthcawl, was to demand greater freedom to fix coal prices, a shorter working week, the restriction of oil imports and an end to opencast mining. He attacked the N.C.B.'s export policy and accused the Government of damaging the national economy. To our mind Mr. Jones, although far from being one of the Union's 'wild men,' displayed an extraordinary unwillingness to face facts. The demand for coal is falling primarily because it is being priced out of the market and because little reliance can be placed on a steady supply of any particular grade. On average a ton of opencast coal costs 58s. 5d. to produce, against 81s. 6d. for a ton from the mines. Thus Mr. Jones is calling for a change of policy which far from making coal cheaper and therefore more generally acceptable would only result in raising the price still further. Perhaps the biggest contribution towards the greater prosperity of the coal industry which the Union can make is to foster a complete change of heart and attitude on the part of the miners. Last year, for example, there were no less than 3,339 unofficial strikes.

During a debate on the National Coal Board last week, Mr. Alfred Robens appeared in the guise of the Board's champion. It is so seldom that one finds *anyone* prepared to champion this much-maligned body that we might pause to note his remarks. Two things, he said, stood out as redounding to the credit of the coal industry. One was that British industry received its coal cheaper than its European competitors, and the other was that output per manshift was the highest in Europe. That showed that the coal industry was not as inefficient as many of its critics tended to make out. The miners were much concerned about the size of the coal stocks and the increasing use of oil. Was it wise to place our fuel and energy programme upon the basis of oil from the Middle East? The coal industry should be the basis upon which our fuel and energy programme should be based, for oil supplies could be interfered with very quickly, and far more quickly than coal.

Therefore, said Mr. Robens, we should go on recruit-

ing miners, putting investment into mining and making British mines technically the most efficient in the world.

Later in the debate Mr. W. R. Blyton (Lab., Houghton-le-Spring) said efforts must be made to improve our large coal production and to look more closely at the problems of supply for power stations, gasification and the briquetting of small coal for use by the railways and domestic grates. As a matter of urgency, the Board should accelerate the introduction of a large-scale briquetting industry and the Gas Council should be encouraged to bring forward as speedily as possible the gasification of small coal.

Mr. R. Maudling, the Paymaster-General, replying to the debate, said the basic principles of the Government's fuel policy were the same as they were when he stated them in April last. First, they based their plans on providing sufficient energy to meet the energy requirements of British industry and of the British economy generally. Secondly, they believed in giving freedom to the user to choose the form in which he wished to take his fuel, whether it be coal, oil, electricity or gas. Thirdly, they wished to see our indigenous sources of energy providing the maximum production they could for the economy and for the balance of payments, although, of course, in the light of the economic cost of so doing. He agreed that the falling demand for coal was a passing phase. If, he said, the coal industry was to come out of this passing phase, in the general context of the demand for fuel as the background to it, it was important that we should keep in mind the competitive position of the coal industry, as compared with the oil industry. It was in the nation's interests, just as it was in the interests of the coal industry, that the competitive position of coal as compared with oil should improve. In that way, we should see more consumption of coal, but not at the cost of imposing restrictions on the right of the user to select the fuel which he thought was most efficient for his own purpose.

Which is all very fine, but the pressure of world events on our oil supplies, coupled with the intransigence of the miners, can make nonsense of such a plan overnight. And that, dear friends, is where we came in.

# *A Boost for Boilers*

LAST week, a change in the purchase tax regulations which is of major importance to the industry crept into certain of our newspapers in an over-condensed and misleading form. Due to an agency error it was stated that gas-operated space heaters had been freed from purchase tax. In fact the alteration refers only to gas-fired central heating boilers and hot water boilers above a certain capacity. Although less exciting than was at first suggested, this tax change is nevertheless extremely good news for the gas industry. The facts are as follows:—Mr. Heathcoat Amory, the Chancellor of the Exchequer, in the concluding stages of the Finance Bill, moved an amendment, which was carried, to exempt central heating appliances fired by gas, from purchase tax. The amendment read: 'As from July 17, 1958, the following gas-burning furnaces for central heating systems, whether or not incorporating electric fans or electric pumps or both, but not otherwise electrically operated, the following—(a) water boilers, but not including appliances of an output of less than 30,000 B.t.u. per hour; (b) appliances supplied with a system of ducting and designed only for the transmission of heated air through such ducting to two or more rooms simultaneously.' Mr. Amory said that oil-fired and solid fuel central heating furnaces were free of purchase tax. Therefore, it seemed wrong that gas-fired furnaces performing exactly the same purpose should remain taxed.

The amendment means that all but the smallest gas-fired boilers are now tax-free and must inevitably give a fillip to the industry. In many ways it was a pity that the news was not given greater prominence. As it is we must rely on the Gas Council and the gas boards giving the maximum publicity to the matter. For the larger ratings in particular competition from oil is tough, but the smaller capacity gas boilers have an excellent, although unfortunately under-publicised, case. What is needed is a concerted effort on the part of the gas industry to sell this type of appliance and get a really worthwhile load.

Let us think for a moment of the advantages which gas has to offer in providing a good hot water and central heating service in a private house. In the first place it has a thermal efficiency of 80%, compared with perhaps 50-60% in the case of a solid fuel installation. The boiler never has to be fuelled, riddled or adjusted to suit the climatic conditions. There are never any ashes to be removed and disposed of and, therefore, no dust created which in the long run means less frequent laundering of kitchen curtains, etc., and less frequent redecoration of the kitchen itself; gone forever are the problems of obtaining supplies of the right type of boiler fuel at the right time.

As far as running costs are concerned, a gas-fired boiler does not have to be kept alight to avoid the unpleasant business of relighting it, and with a clock controller the boiler can be made to fit in with the family habits and usage of hot water, shutting down at a predetermined time every evening and lighting up again every morning. With a four tappet clock controller the boiler can also be made to shut down in the morning after the family have left home, leaving sufficient hot water in the storage cylinder to meet the housewife's requirements during the day and lighting up again before the family's return in the evening.

Inevitably in selling gas for this purpose one comes up against competition from oil. In the smaller sizes, at any rate, oil need not have a price advantage over gas, but in many cases it will have and gas must then be sold on its superiority as a fuel. What are the disadvantages of oil? They are, we suggest (i) higher capital cost (for storage tank, etc.), (ii) smell (a very serious disadvantage if the boiler is to be placed in the kitchen), (iii) danger of seepage, (iv) unreliability due to the unrest which always seems to be centred on the oil routes, and (v) the fact that oil is not smokeless.

Above all we believe that success in selling boilers and air heaters depends on the enthusiasm and confidence of the industry.

# Personal

EARL OF HALSBURY is to retire from the position of Managing Director of the National Research Development Corporation on March 31, 1959, to take up another appointment. Lord Halsbury was appointed temporary adviser to the Board of Trade in May, 1949, in anticipation of the establishment of the Corporation and his appointment as its first Managing Director was made at the end of June, 1949. He was, therefore, responsible for the launching of the Corporation and will, by next March, have directed its activities for nearly ten years.

MR. J. STRONG, Executive Director of British Oxygen Gases Ltd., has been elected President of the Institute of Welding for 1958-59 in succession to SIR CHARLES LILLICRAP, K.C.B., M.B.E. Mr. A. CLIFFORD HARTLEY, C.B.E., Mr. G. ROBERTS and Mr. E. SEYMOUR-SEMPER have been elected Vice-Presidents for 1958-59.

MR. H. R. WALKER, Horstmann Gear Co. Ltd., Representative for London and the Home Counties, has now moved to the following address—'Reklaw,' Raglan Road, Reigate, Surrey. Tel.: Reigate 4669.

MR. H. MCKAY KENNEDY, Finance Department, Scottish Gas Board, passed the intermediate examination in May of the Institute of Municipal Treasurers and Accountants.

MISS MARGARET P. SMITH, Finance Department, Scottish Gas Board, Dundee Group, who had passed part A at a previous examination, passed the final part B examination.

The appointment of six area managers by United Gas Industries, Ltd., announced in these columns last week, concerned the Company's Engineering and Appliance Division only.

# London and Southern Section Hold Summer Meeting at Eastbourne

A TIME, 15 years ago, when the gas engineer's office was so placid that one expected the gramophone to play 'In a Monastery Garden,' was referred to by Mr. C. Stott, the Chairman, at the Summer Meeting at Eastbourne of the London and Southern Section on July 8. In those days, he said, the engineer's biggest job was to decide whether to replace or repair a bench of retorts.

Mr. Stott contrasted this blissful state of affairs with the situation today with the gas industry rapidly taking on a new look. It was the period of rapid progress through which the industry was now passing which had tended to make his year of office a heavy one. In those circumstances he had greatly appreciated the guidance and support of his Chairman, Mr. W. K. Hutchison, and the help of many others, in particular the Section Secretary, Mr. J. T. Veryard.

Mr. Stott was replying to the toast of the Section proposed by Mr. Hutchison, who had referred to the high quality of the papers presented during the year and to the valuable interchange of knowledge which had resulted. Of the industry as a whole Mr. Hutchison said that what had started as evolution had become a revolution in gas making.

The increasing network of transmission mains, the freedom to choose raw materials, the trend towards processing poor coal, and the profit experienced by many boards in basing their plants near oil refineries— all these were contributing to a new conception of the gas industry. In such circumstances much depended on the men who would run this new industry and in this the I.G.E. bore a great responsibility.

An earlier speaker at the luncheon, held at the Grand Hotel, had been the Mayor of Eastbourne, who had welcomed members to the town and had referred to the fine weather which had graced their visit. This prompted Mr. Hutchison to remark that the good gas man thought of the merry tinkle of shillings in the meter during the last 'flaming' June.

During the morning members had visited the Friston pumping station of the Eastbourne Waterworks Company— which Mr. Stott called 'the technical peg' on which to hang the days proceedings—and during the afternoon they participated in a coach tour of the surrounding countryside.

# *GASHOLDER BLAZE HALTS TRAINS—BUT OIL WAS BURNING*

GAS was blamed for a gasholder fire that halted main line rail traffic for an hour and a half at Portsmouth on Monday. In fact, waste oil was burning. And train services were dislocated because the fire brigade disdained to use the copious supply of water on the gasworks, preferring a hydrant of their own choosing across the railway line.

The holder was disconnected and empty at the time and undergoing renovation and repairs. Sparks from an acetylene blow torch ignited the waste oil at the holder's base. Clouds of thick black smoke rose up.

But there was no danger to life or property—least of all to the trains which might have passed if the lines had not been cluttered up with hoses.

# N.C.B. SURPLUS DOWN £5 MILL. IN FIRST QUARTER OF 1958

DURING the first quarter of this year, the National Coal Board made a surplus of £3.8 mill., compared with just under £8.8m. in the first quarter of 1957, when coal sales were helped by the interruption of oil supplies after Suez.

The financial results were roughly as expected and reflected lower output and increasing unsold coal stocks. The position would have been worse but for the cold spell which raised demand for house coal and other forms of space-heating, and for the fact that the loss on imports was relatively small at just over £1 mill.

Total profits before interest payments to the Minister of Power amounted to just under £11½ mill. Colliery profits amounted to just over £8¼ mill., and profits on opencast to £2.47 mill.

# South Western Section Visit New Oil Gas Plants at Gloucester

## *SUMMER MEETING AND LADIES' DAY*

SOME 80 members and guests attended the recent Summer Meeting and Ladies' Day of the South Western Section of the I.G.E., in Gloucester.

The morning's proceedings included a visit of the members to the Gloucester manufacturing station to inspect the new oil gas plants, while the ladies were welcomed by Mrs. T. L. Tallentire, the Chairman's wife, to coffee at the Bell Hotel.

At the luncheon, also at the Bell Hotel, the Chairman proposed a toast to the ladies and guests, and Mr. J. Powdrill, M.B.E., Honorary Secretary of the Wales and Monmouthshire Section, replied. Mr. C. H. Chester, C.B.E., Chairman of the South Western Gas Board, was among those present at the meeting and luncheon.

During the afternoon a visit was made to the Severn Wildfowl Trust at Slimbridge and tea was taken at the Berkeley Arms Hotel, Berkeley, Gloucestershire, where many of the party also visited the historic castle.

## Correction

We regret that on page 153 of last week's 'JOURNAL' the prices for 'Manual of Gas Fitting' and 'Domestic Utilization of Gas' were incorrectly given. The prices should be 40s. for 'Manual of Gas Fitting' and 20s. for 'Domestic Utilization of Gas.'

# *Diary*

**July 29.**—WALES G.C.C.: Gas Offices, Bute Terrace, Cardiff. Meeting, 11 a.m.

**July 31.**—NORTH THAMES G.C.C.: Westminster City Hall, Charing Cross Road, London, W.C.2.

# N.T.G.B. Transport Drivers Covered 10 mill. Miles in Past Year

## *MANY RECEIVE SAFETY AWARDS*

*Mr. E. S. Caplin, Transport Manager, North Thames Gas Board (centre), is seen talking to Mr. P. H. Lambert (left) and Mr. A. J. Smith, both of whom have completed 30 years' driving without an accident.*

ALMOST 10 mill. miles in and around London and the Home Counties have been covered during the past year by drivers of the North Thames Gas Board. During that period, 663 of the Board's drivers were accident-free, and so qualified for awards in connection with the safe driving competition sponsored by the Royal Society for the Prevention of Accidents.

In completing a further year without an accident, several of these 663 drivers achieved continued safety records of up to 30 years, and qualified for additional major awards made at a recent ceremony at the Board's offices in Vincent Street, S.W.1. Making the presentations was Mr. R. N. Bruce, Deputy Chairman of the Board, who congratulated the men on their record.

A guest at the presentation ceremony was Chief Superintendent J. Bidgood of the Traffic Department, Scotland Yard, who added his own tribute to the safety record achieved by the Board's drivers. Major F. W. Firminger, of Ro.S.P.A., also congratulated the drivers.

Since the safe driving competition was started, drivers of the North Thames Gas Board have gained 1,474 of these major awards, ranging from 722 men with five accident-free years to one man with a record of 35 years' driving without an accident.

## *Challenge of Change*

The Challenge of Change—the challenge to managers of the economic, political and technological changes of the modern world—is to be the theme of the 1958 National Conference of the British Institute of Management. It will be opened by Mr. Peter Thorneycroft and will be held in Brighton from November 26-28.

## N.C.B. CHIEF SEES DIFFICULTIES THEN SUCCESS

THERE is 'in the short term, I am afraid, no quick or easy answer to the difficulties which face us, but a hard test of our mettle in which everything may depend upon our ability to achieve the twin and interdependent objectives of an economic level of production at the maximum possible efficiency, together with the most vigorous drive in the markets of coal,' said Sir James Bowman, K.B.E., Chairman of the National Coal Board, when he addressed the annual conference of the National Union of Mineworkers at Porthcawl recently.

'In the long term—more intense competition,' continued Sir James. 'But a continuing and renewed demand for coal, and a strong and vigorous industry to meet that demand.

'I have said that to fight effectively, is to fight on grounds of our own choosing. And I can say that, so far as our fight is concerned we choose, and will continue to choose our ground most carefully.

'But having chosen, the effort of every man in the industry must be thrown into the contest.'

# *Fulham are Winners of N.T.G.B. First-Aid Competition*

SCORING a record number of points, the Fulham works of the North Thames Gas Board, have, for the fifth successive year, won the annual first-aid competition organised by the Board, and held recently at the Commercial Institute in Poplar. The Fulham team—Mr. S. Jones (captain), Mr. R. McDaniel (class leader), Mr. H. A. Eatenton, Mr. S. T. Hall, and Mr. E. T. Stephens (reserve), will represent the Board in the gas industry's first-aid competition later this year.

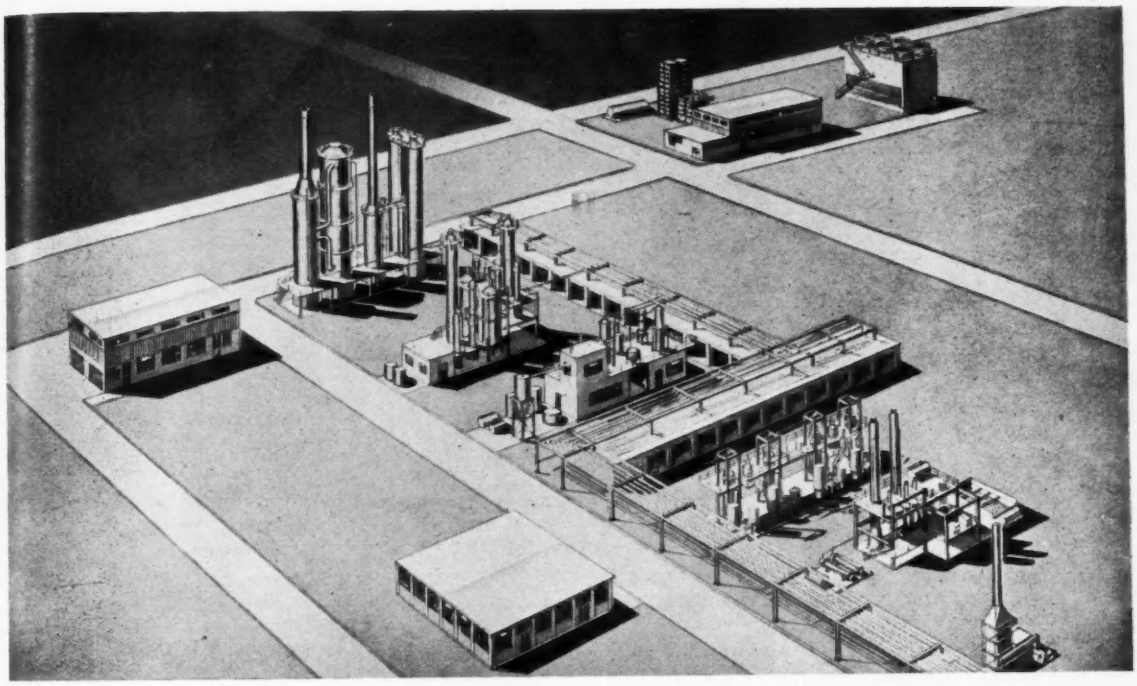
From an original entry of 27 teams, drawn from the Board's works and departments, the top ten teams underwent a team test, judged by Dr. M. M. Scott, Deputy Surgeon-in-Chief, St. John Ambulance Association, and 'pairs' tests, judged by Mr. C. E. Croft, the Association's Competition Secretary.

Second to Fulham was the team from Slough works and in third place was Kensal Green. The latter team have a particularly consistent record in the competition for they, in company with the Stove Department, Haggerston, have appeared in every final since the competition was re-started in 1947.

This year, for the first time, a plaque was awarded to the first-aid class obtaining the highest percentage of marks in Part 1 of the competition, and the first winners of this was the Haggerston team.

Individual plaques for the first three teams and the Board's first-aid shield were presented at the end of the competition by Mr. R. N. Bruce, Deputy Chairman of North Thames Gas, who congratulated the winners on their continued success and paid tribute to the work done and enthusiasm shown by all first-aiders.

*Mr. R. N. Bruce (right), Deputy Chairman, North Thames Gas Board, presents the first-aid shield and plaques to the Fulham team.*



*Pictured above is a pespective drawing of the new high pressure process gas from oil plant to be built at the South Eastern Gas Board's Isle of Grain works by Woodall-Duckham Construction Co., Ltd., comprising Shell gasification plant with associated oxygen plant as well as ancillary plants for $H_2S$ removal, CO conversion, $CO_2$ removal and power generation.*

# Meters Ltd. Profit Rose £14,000 During Last Trading Year

## *'Very Considerable Improvement,' says Chairman*

IN his review accompanying the accounts for the Company's financial year ending March 31, 1958. The Chairman, Mr. V. A. B. Hughes, said the trading results was a very considerable improvement over that for the previous year, showing a net profit before tax of £46,598, compared with £32,511. Their domestic meter production was now devoted entirely to an improved model which had given great satisfaction to their customers.

The Board had decided to recommend a final dividend of 3½%, making the year's Ordinary dividend 6%, as for the previous year. The carry forward was £17,061, slightly more than was brought into the accounts.

During the year they had acquired a controlling interest in a gas meter manufacturing company in London and were now utilising its modern factory which had enabled them to close their London factory and to let it on favourable terms.

A further subsidiary company had been created, which was now acting as the sales company for their specialised engineering products.

They had also closed their Middlesbrough factory as a further step in their policy of concentration.

They were feeling the difficulties occasioned in one portion of their productive programme by reduced Government demand, directly and indirectly, for the precision products they had made in the past with considerable success. But they hoped to be able to supplement from other sources this branch of their business until Government requirements revived.

# Clean Air Drive for Yorkshire

THE Solid Smokeless Fuel Federation is to start an eight-month clean air campaign in the West Riding of Yorkshire in September.

Sponsored by the West Riding Clean Air Advisory Council, the campaign will move through Wakefield, Ossett, Dewsbury, Castleford, Halifax, Batley, Barnsley, York, Bradford, Huddersfield, Pontefract, Doncaster, and Leeds.

# Coalite Company Sets Up Records Despite a Difficult Period

IN his statement accompanying the report for the year ended March 31, 1958, the Chairman of Coalite and Chemical Products, Ltd., Commander Colin Buist, M.V.O., said that despite difficulties during the period under review the Company had established new records in production, sales, and profits.

Working profit, after depreciation and before taxation, amounted to £774,400 compared with £670,389 for the previous year. Unfortunately, income and profits taxes has absorbed a large part of the increase in gross profit, but the net profits of the Group increased from £340,490 to £365,814. A final dividend of 10%, making 13% for the year, was proposed (against 12½% in 1957).

A resolution was to be proposed increasing the Company's authorised capital to £4 mill. by the creation of an additional 20 mill. shares of 2s. each. There was no present intention, however, of issuing further share capital.

Turning to the outlook, the Chairman said the trade recession had affected certain sections of the chemical market with which they were concerned and competition had been even more severe during the last three months. They were trimming their sails accordingly.

A preliminary appraisal of the new situation arising out of the ending of coal rationing suggested that their competitive position would not be affected. Coalite was primarily a fuel for the open fire and the shortage of top quality house coal continued. The Clean Air Act now in full force, had been well received. Smokeless zones were spreading rapidly. Much remained to be done but under the new law it was only a matter of time. All this was in their favour.

*This paper is published by courtesy of the Institute of Fuel*

# Desulphurisation of Coke-oven Gas at Appleby-Frodingham

By L. REEVE, Ph.D., B.Sc., F.I.M.,

CHIEF METALLURGIST, APPLEBY-FRODINGHAM STEEL COMPANY.

THE paper describes tests on the absorption of $H_2S$ in coke-oven gas by hot iron oxide, both in static and fluidised beds. These experiments led to the installation and testing of a large pilot plant dealing with approximately 2½ mill. cu.ft. of coke-oven gas per day using fluidised beds of hot oxide, the sulphided material being re-cycled through a regenerator in which the oxide is roasted at from 600° to 800°C. in a stream of air, and is then returned to the absorber. Details of construction and operation of this plant are given. The influence of desulphurised gas on the sulphur content of the steel produced in large open-hearth furnaces using this gas is also described.

The use of iron oxide for desulphurising industrial gases has been established for many years. Cold hydrated iron oxide was first used by Frank Clark Hills in 1849, who was also aware that it could be revivified by exposure to the air. Since those early experiments on oxide desulphurisation numerous improvements in points of detail have been introduced, covering, for example, the preparation of special activated oxides and improved methods of charging and discharging the containers holding the oxides. Despite the high efficiency of the process in terms of percentage desulphurisation achieved, there have been numerous criticisms of oxide desulphurisation, the chief of these being:—

(*a*) The high capital cost of the plant.
(*b*) The large area of ground required.
(*c*) The dirty handling problem in charging and discharging of boxes and the associated labour problem.
(*d*) The difficulty of finding a market for the spent oxide.

## Air Added

The greatest attraction of the process is the high percentage desulphurisation achieved, although this can be done only at very low space velocities, and, to maintain it, regular and careful attention to numerous points of detail is necessary. It should be noted also that the process does not remove the organic sulphur in the gas. A small percentage of oxygen (as air) is normally added to the incoming crude gas to assist in oxidising the sulphide produced, with the deposition of free sulphur.

A proposal to improve the process by the introduction of the modern technique of fluidising was made by Garside and co-workers, who have reported the results of laboratory-scale fluidising tests between 1948 and 1952.[1,2,3] These tests were carried out at approximately 35°C. They proposed to remove the deposited sulphur in suitable organic solvents and to re-use the extracted iron oxide.[4]

It is understood that the process was tried out on a small pilot-plant scale, but no detailed report on this work is available and the process has not been applied on an industrial scale.

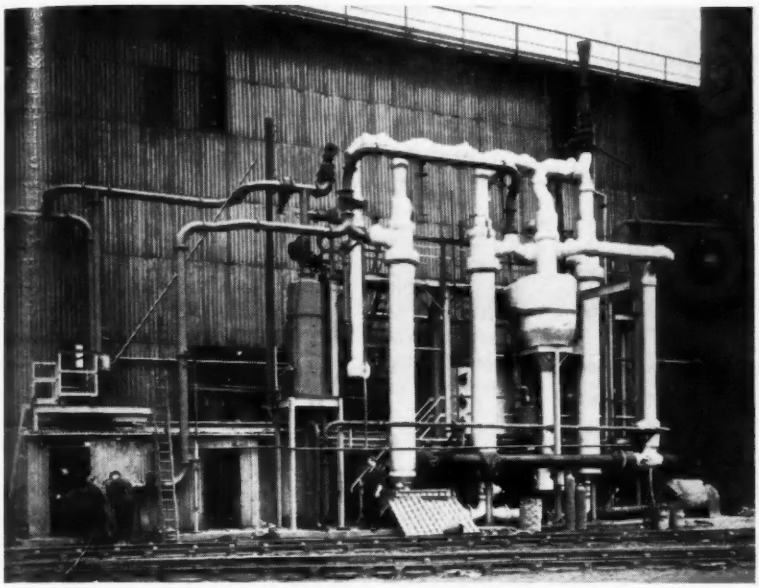
The present paper describes the development of a fluidised iron-oxide process which is operated at a temperature of 350° to 400°C. The sulphided ore is conveyed to a regenerator chamber where it is oxidised in a current of air at 600° to 800°C., the exit gases being suitable for sulphuric acid manufacture. No oxygen is added to the incoming crude gas.

## Heat Exchange

The regenerated oxide is returned to the absorber where it provides about one-third of the heat requirements of the process, the remainder being obtained by heat exchange of the cold incoming crude gas against outgoing hot desulphurised gas in a suitable heat exchanger. The process has been in operation on the scale of approximately 2½ mill. cu.ft. per day since April, 1956, at the Appleby Steelworks of the Company with which the author is associated, and preparations are in hand to extend it to the full scale of 32 mill. cu.ft. per day, in conjunction with the recovery of the associated sulphur as sulphuric acid.

Over 95% sulphur absorption has been achieved from gas containing 600 grains of $H_2S$ per 100 cu.ft. in conjunction with the removal of about the same percentage of organic sulphur. With suitable modifications it is possible to raise the sulphur removal almost to 100% and to exceed Gas Referee standards of purification.

The original trials on a laboratory scale were carried out at Appleby-Frodingham between 1946 and 1948, and formed the basis upon which British Patent No. 719,056 was applied for in 1950. The first laboratory tests were done in a simple 1 in. diameter quartz tube heated in an electric furnace, containing a column of 100 grams of iron oxide crushed to −16 mesh. Crude coke-oven gas was blown through the column at various temperatures between 20° and 700°C., and the degree of



*Pilot plant for desulphurisation of coke-oven gas; two-bed absorber.*

absorption of $H_2S$ determined by analysing the exit gas. The degree of absorption at room temperature was low, but it rapidly increased as the temperature was raised. Typical results at 250°C. are shown in Table 1.

It will be noted that absorption under these conditions is practically complete. Subsequent runs showed that at this temperature this continued until the bed contained at least 10% of sulphur (as FeS), while at higher temperatures nearly 30% of sulphur could be absorbed before any sign of 'break through' took place.

The 'space velocity' in the above trial at 250°C. expressed as the ratio $\frac{\text{gas volume treated/hour}}{\text{volume of oxide}}$ was approximately 100. Similar trials at 450°C. raised this ratio to over 140. In both these runs, however, the column of oxide was static.

TABLE 1.—EARLY LABORATORY TESTS ON DESULPHURISATION OF COKE-OVEN GAS BY IRON OXIDE AT 250° C
100 *grams oxide*
*Rate of gas flow approximately* 10 *litres per hour*

| Run No. | Duration of run hours | Volume of gas passed litres | Per cent $H_2S$ incoming gas | Per cent $H_2S$ out | Sulphur absorbed grams |
|---|---|---|---|---|---|
| 1 | 2·5 | 30 | 0·92 | trace | 0·396 |
| 2 | 3·5 | 34 | 0·80 | trace | 0·396 |
| 3 | 3·0 | 25 | 1·01 | trace | 0·360 |
| 4 | 3·0 | 25 | 1·07 | trace | 0·380 |
| 5 | 1·75 | 15 | 0·78 | trace | 0·168 |
| 6 | 5·0 | 50 | 1·26 | trace | 0·90 |
| 7 | 2·5 | 22·5 | 1·83 | trace | 0·58 |
| 8 | 2·75 | 25 | 1·68 | trace | 0·60 |
| Total | 24 | 226·5 | 1·17 | trace | 3·78 |

Subsequent trials were carried out in a vertical bed of oxide supported on a perforated disk, the gas flow being raised to a sufficient extent to fluidise the bed. A large number of trials of this type have been carried out; a very complete series of runs at temperatures of 325°C., 350°C., 375°C. and 400°C., at two different gas rates (600 and 1,200 litres/hour), in a 5 cm. diameter fluidised reactor, is summarised in Table 2. The percentage of $H_2S$ absorbed represents the average results over the first 60 minutes of each run.

TABLE 2.—ABSORPTION OF $H_2S$ FROM RAW COKE-OVEN GAS CONTAINING APPROXIMATELY 1% $H_2S$ BY VOLUME IN A FLUIDISED BED OF IRON OXIDE

| Gas flow<br>Bed weight<br>Bed height | 1,200 litres/hour<br>760 grams<br>20 cm | 600 litres/hour<br>380 grams<br>9·5 cm |
|---|---|---|
| Temperature °C | Percentage $H_2S$ absorbed | Percentage $H_2S$ absorbed |
| 325 | 73·5 | 71·0 |
| 350 | 80·6 | 80·1 |
| 375 | 87·2 | 87·4 |
| 400 | 94·7 | 94·1 |

Substantially the same results were obtained in both series of tests at each temperature.

The space velocity in both series of runs, expressed again as $\frac{\text{volume of gas/hour}}{\text{volume of oxide}}$, has now risen to the very high value of 3,000. The marked dependence of reaction rate upon the temperature, within a fairly narrow range, should be noted.

## Degree of Reduction

A further series of runs in the same equipment at three different space velocities at four temperatures is reported in Fig. 1, curves AA, BB, CC and DD. (The space velocities on the abcissae of this diagram have been expressed slightly differently, in the form cu.ft. of gas per hour per lb. of oxide. They can be converted into the previous units by multiplying by the factor 80.) The results summarised by the dotted curve EE will be discussed later.

As might be expected a certain degree of reduction of the iron oxide takes place in conjunction with the desul-

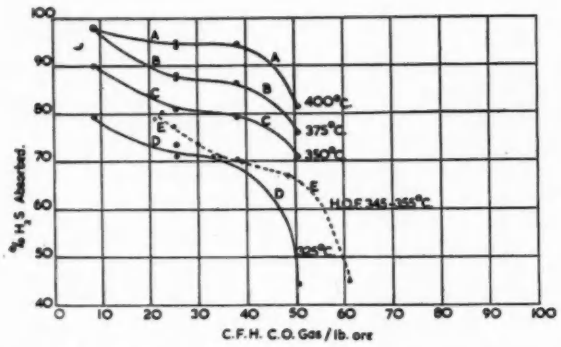



*Fig. 1.—Percentage of $H_2S$ absorbed plotted against space velocities expressed as cubic feet of gas per hour per pound of ore.*

phurising reaction, the extent depending upon time and temperature of operation. Thus, on analysing the column of ore used in the 24 hour laboratory run summarised in Table 1, the results shown in Table 3 were obtained.

TABLE 3.—ANALYSIS OF IRON OXIDE COLUMN AFTER $H_2S$ ABSORPTION FROM 1% $H_2S$ GAS FOR 24 HOURS at 250°C

| | Fraction weight per cent | Total Fe per cent | Ferrous Fe per cent | Total S per cent | Sulphide S per cent | Sulphate S per cent |
|---|---|---|---|---|---|---|
| Gas inlet end . | 28·1 | 46·9 | 30·8 | 10·89 | 10·25 | 0·64 |
| Middle . . | 34·8 | 46·9 | 7·6 | 1·80 | 1·34 | 0·46 |
| Gas outlet end . | 37·1 | 46·9 | 3·4 | 0·096 | 0·055 | 0·041 |
| Weighted average, per cent . | 100·0 | 46·9 | 12·6 | 3·76 | 3·38 | 0·36 |

In the pilot plant the ferrous iron is largely re-oxidised in the regenerator, contributing a further quota of heat to the circulating ore owing to the heat of oxidation of FeO to $Fe_2O_3$.

Laboratory trials were also carried out to determine the effect of regenerating the sulphided oxides by roasting in air at temperatures up to 800°C., to determine whether such ores maintain their desulphurising activity. Some reduction in rate of reaction compared with fresh oxide was found, but not sufficient to affect its usefulness. The number of reversals which can be carried out conveniently under laboratory conditions is necessarily limited, but subsequent results in the pilot plant have indicated that the ore can be sulphided and regenerated many hundreds of times and still retain useful activity. As will be indicated later, the final rejection of the ore from the plant is governed by its breakdown in size and not by its loss of activity.

In 1953 interest in the desulphurisation of coke-oven gas was revived at the Appleby melting shop because of differences noted between steel sulphurs from open-hearth furnaces burning mixed coke-oven and blast-furnace gas, and steel from similar furnaces using cold coke-oven gas plus pitch creosote. This latter combination of fuels has an appreciably higher sulphur content than the former, and produced finished steel averaging 0.006% more sulphur. As it was intended to change over steadily to cold coke-oven gas firing it was felt desirable to desulphurise this gas in the hopes of counteracting the expected higher sulphurs. This point will be returned to later in this paper.

## Steel Reactor

The tests of the hot oxide process were therefore extended in 1953 to the use of a 6 in. diameter steel reactor using approximately 60 cu.ft. of gas per hour, which substantially confirmed the degree of desulphurisation reported in the laboratory trials. These trials were combined with oxidation tests in air, repeated sulphiding and oxidation runs (10 cycles) being carried out to determine whether the oxide could be used repeatedly without serious loss of activity. Calculations were also carried out on the probable heat balance of the process and the first estimates of its probable economics were made. These indicated that the operating costs were likely to be reasonable, while the advantage of freedom from corrosive effluents known to be troublesome in certain existing wet processes was an added attraction. Laboratory experiments indicated absence of cyanides in the sulphided ore which would mean freedom from

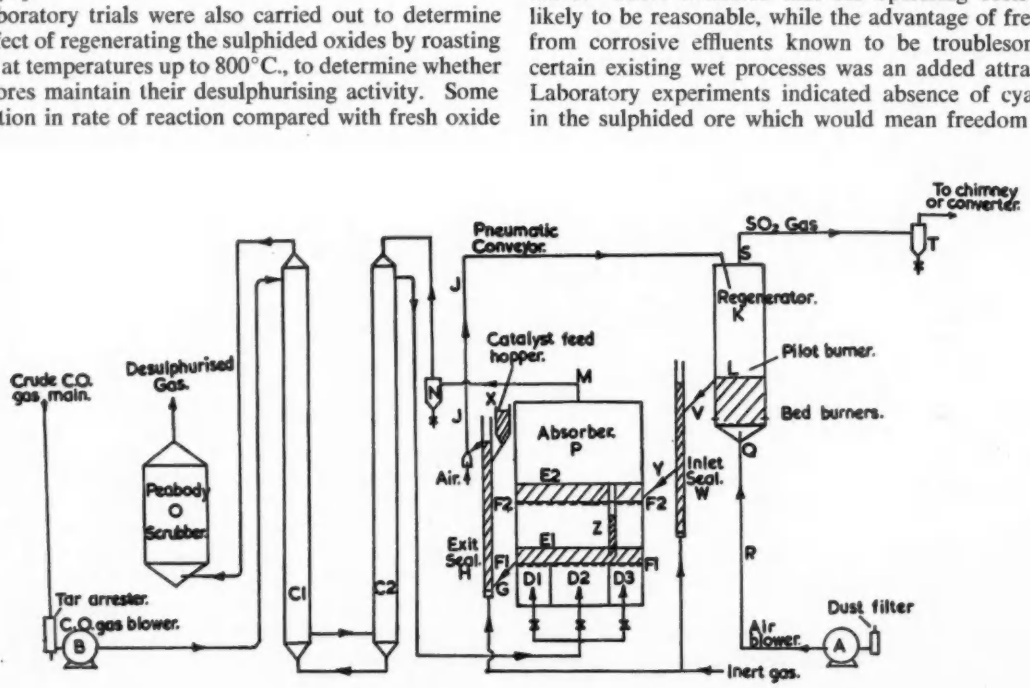



*Fig. 2.—Diagram of pilot plant for desulphurisation of coke-oven gas; two-bed absorber.*

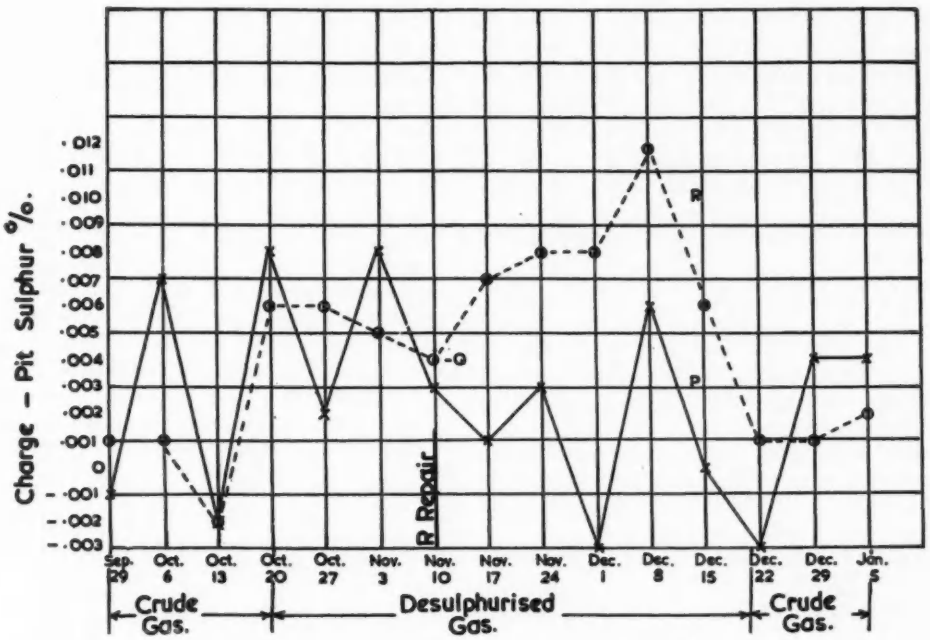



*Fig. 3.—Average amount of sulphur removed weekly between charge and tapping (charge—pit sulphur) for R furnace (desulphurised gas as shown), and P furnace (crude gas throughput).*

oxides of nitrogen in the regenerator gases. This has since been confirmed in the pilot plant and is an important advantage of the process.

No accurate estimates of capital cost were possible at this stage, but preliminary consideration suggested that a large-scale plant was not likely to be particularly elaborate as compared with existing processes. No exact information on this aspect was possible without larger-scale tests.

On the basis of these considerations it was agreed to install a suitable pilot plant to test the process on a larger scale. In view of the interest of the Appleby melting shop in the process it was decided to install a plant capable of desulphurising the maximum gas requirements of one of the large Appleby 350-ton tilting furnaces, which amount to approximately 2.5 mill. cu.ft. of coke-oven gas per day, the object being to carry out sufficient trials on this scale to find out if the process was technically and economically practicable and what effect it had on the amount of sulphur in the steel produced compared with the amount in the steel produced in an adjacent furnace using crude coke-oven gas.

## Blowing Trials

Installation of the pilot plant on a site adjacent to R furnace was begun in September, 1955, and completed in March, 1956. Preliminary blowing trials were started in January, 1956, and the first hot desulphurising test was made in April, 1956. A simplified line diagram of this plant is shown in Fig. 2, together with a photograph on page 177. It should be mentioned that the details of the oxide circulation system between the absorber and the regenerator, together with those of the inlet and exit seals, were worked out in the first place on a 2 ft. diameter model rig using cold air to fluidise the beds of ore in the vessels. These details, suitably modified, were transferred to the larger vessels of the pilot plant, an arrangement which has worked very satisfactorily in practice.

## Impingement Plates

From Fig. 2 it will be seen that crude coke-oven gas is forced by blower B through the shells of heat exchangers C1 and C2, where it is preheated to about 250°C., and enters the blowing box at the bottom of the absorber vessel P, at pipes D1, D2 and D3, at a velocity sufficient to fluidise the bed of oxide E1 which is carried on a suitably perforated distribution plate, F1F1. The hot desulphurised gas leaves at exit pipe M through cyclone N, and the tubes of the heat exchangers C1 and C2, where it transfers about 65 per cent. of its heat content to the incoming cold gas, and finally leaves the plant via the Peabody scrubber, O, where it is washed in a series of water sprays, and where the remaining dust is removed from the gas by a series of special water washed impingement plates.

Considering now the flow of solids in the plant, the sulphided oxide in the absorber is transferred via pipe G to a fluidised exit seal H, and is conveyed by a stream of air through conveyor JJ, into the regenerator vessel K. Here it falls into the bed L, which is fluidised by a stream of air entering at pipe Q, via pipe R and blower A.

The sulphur is oxidised to $SO_2$ (plus some $SO_3$) and leaves via pipe S and cyclone T to the chimney; in a full-scale plant these gases will go to a suitable sulphuric acid contact plant. Sufficient heat is generated during oxidation to maintain the bed at a temperature from 600° to 800°C. This hot oxide is transferred in due

course via pipe V, fluidised inlet seal W and pipe Y, back to the absorber bed E. The hot ore provides the final 35% of the total heat required to raise the cold incoming gas to the operating temperature of approximately 380°C., the remaining 65% having already been provided, as previously mentioned, by the heat exchangers. Once properly adjusted, this cycle of operations repeats itself continuously, the residence time of the oxide in the bed being controlled by the rate at which it is blown through the conveyor JJ and by the volume of the bed.

## Fluidising Rates

Slow breakdown of the ore takes place during the above described processes, and the ore fines are separated at the two cyclones N and T. Fluidising rates have been adjusted deliberately in such a manner that most of the fines are carried over from the regenerator and collected at cyclone T as oxidised material; the sulphided oxide collected at cyclone N represents only a small proportion of the total fines. The weight of fines lost in this manner from the system amounts on the average to about 4,000 lb. per week, during which time nearly 20 mill. cu.ft. of gas are desulphurised, *i.e.*, about 5,000 cu.ft. of gas per 1 lb. of oxide. Oxide fines are run off from the cyclones periodically via the dip leg valves, while an equivalent weight of make-up material is added periodically through hopper X and exit seal H.

## Typical Results

Laboratory results already described had indicated that the percentage desulphurisation attained in the pilot plant could be expected to depend upon the following four factors:—

(*a*) Bed temperature.
(*b*) Bed depth.
(*c*) Rate of blowing.
(*d*) Possibly ore sizing (not fully investigated).

The effect of the first three of these factors in the pilot plant with the fourth constant at −16 down to approximately 100 mesh is summarised in the dotted curve EE in Fig. 1. It will be noted that the degree of desulphurisation attained in the pilot plant is only slightly lower than that attained in the laboratory unit at similar space velocities and temperatures. Some typical results for a blowing rate of 95,000 cu.ft. per hour and a bed temperature of 340° to 360° C. over a 10-week period between October 14 and December 15, 1956, are summarised in Table 4. The slightly lower figures in the first two weeks were due to working at the lower end of the temperature range mentioned above, while the slightly higher figures in the later weeks correspond to the upper limits.

TABLE 4.—TYPICAL RESULTS FOR A BLOWING-RATE OF 95,000 CU. FT. PER HOUR (BED TEMPERATURE 340° TO 360° C).

| W.E. 1956 | Average $H_2S$ removal per cent |
|---|---|
| October 20 | 71·3 |
| October 27 | 76·6 |
| November 3 | 80·1 |
| November 10 | 81·8 |
| November 17 | 82·2 |
| November 24 | 80·4 |
| December 1 | 83·4 |
| December 8 | 82·6 |
| December 15 | 82·2 |

It was noted during the operation of the plant that the effect of increasing bed depth when using a single bed was less than linear. It followed that there might be advantages in running two or more shallow beds in series rather than one deep bed. This was first checked on a laboratory scale using two furnaces and 1 in. reaction tubes in series, in each of which was maintained a fluidised bed of ore in the temperature range 300° to 390° C. These results indicated that with crude coke-oven gas containing approximately 1% of $H_2S$, overall figures of percentage desulphurisation from 95 to 99 might be expected, depending upon the temperature. In view of the importance of these results it was decided to check them on the large scale in the pilot plant, by installing a second bed, E2, in the absorber P. A vertical transfer pipe Z connected the two beds. The incoming ore pipe Y had to be raised so as to feed hot ore from the inlet seal W into the upper bed, from whence it fed into the lower bed via the transfer pipe Z. Under these conditions the degree of desulphurisation of the coke-oven gas was found to be from 95% to nearly 99% as predicted. The following are the results over a 23-hour period when desulphurisation averaged over 98%.

TABLE 5.—DESULPHURISATION IN TWO-BED SYSTEM IN PILOT PLANT 95,000 CU. FT. PER HOUR

| Date 1957 | Time | Desulphurisation per cent |
|---|---|---|
| May 7 | 11.20 a.m. | 98·8 |
| May 7 | 2.30 p.m. | 98·6 |
| May 7 | 3.30 p.m. | 98·6 |
| May 7 | 4.50 p.m. | 98·6 |
| May 7 | 8.15 p.m. | 98·1 |
| May 8 | 1.30 p.m. | 98·1 |
| May 8 | 5.45 a.m. | 98·2 |
| May 8 | 9.25 a.m. | 97·1 |
| May 8 | 10.25 a.m. | 97·5 |

Further improvements on these figures have been shown to be possible on a laboratory scale by various modifications which are now being introduced into the pilot plant. It is confidently expected that these changes will raise desulphurisation limits to Gas Referee standards with regard to $H_2S$, and in addition will remove most of the organic sulphur.

## Analytical Procedure

The removal of organic sulphur in this process has been investigated both in the laboratory and on the pilot-plant scale. The analytical procedure used has been to pass a known volume of the gas to be tested through neutral cadmium chloride solution to remove $H_2S$, followed by complete combustion of the remaining gases over platinised asbestos, with excess air, followed by oxidation in neutral hydrogen peroxide with subsequent analysis for $H_2SO_4$. The following determinations of organic sulphur removal were carried out during

the course of the development work reported above, and show the percentage removal of organic sulphur in relation to the simultaneous $H_2S$ removal. The operational temperatures ranged from 320° to 400°C.

TABLE 6.—FRODINGHAM DESULPHURISATION PROCESS
*Removal of $H_2S$ and of organic sulphur from coke-oven gas*

| Test No. | Inlet gas grains per 100 cu. ft. | | Outlet gas grains per 100 cu. ft. | | Percentage removal | |
|---|---|---|---|---|---|---|
| | $H_2S$ | Organic S | $H_2S$ | Organic S | $H_2S$ | Organic S |
| 1 | 516·4 | 19·9 | 228·2 | 8·7 | 55·8 | 56·2 |
| 2 | 675·4 | 14·25 | 170·7 | 3·78 | 74·8 | 73·6 |
| 3 | 577 | 39 | 17·3 | 1·4 | 97·0 | 96·4 |
| 4 | 638 | 13 | 0·06 (0·9 parts per million) | 0·13 (1·9 parts per million) | 99·99 (Laboratory scale only) | 99·0 |

It will be noted that the degree of organic sulphur removal runs parallel with the percentage $H_2S$ removal. This strongly suggests that the hot oxide used acts as a catalyst for the conversion of organic sulphur to hydrogen sulphide which is then absorbed by the oxide.

Operation of the plant normally proceeds without incident. Two plant operators are present on each shift, but only because the plant is in a comparatively isolated part of the works. It is expected that on the full-scale plant the second operator will look after the sulphuric acid contact plant. The plant is self-sustaining on temperature once the plant has started up (which is arranged by using pilot burners in the regenerator). Once the circulating ore attains 250°C., these preheating units are switched off and the plant is then brought up to temperature by the ore circulation and heat exchanger system. Bed depths are kept under observation by reading pressures in conjunction with bed-depth-level indicators of the Tektor probe type. A radio isotope bed-level indicator is also being tried.

## Pressure Switches

Minor operating troubles have been caused by pressure fluctuations in the plant arising from the sudden closing of valves on the steel furnace with which it is connected and two pressure switches have had to be inserted as safety devices. These troubles are related to the direct coupling of the pilot plant to a steel furnace, and should be reduced considerably on a full-sized plant, which is desulphurising gas for all the furnaces in the works.

The inlet and exit seals have been introduced as a safety measure to ensure a more positive separation of the ore flowing between the regenerator and absorber. These seals are kept agitated by a slight gas flow, preferably of some inert gas. In addition, the exit seal acts as a convenient means of charging fresh ore into the system during operation. On closing down the plant, it is usually cooled in contact with the gas stream and then purged with carbon dioxide gas, a battery of cylinders of this gas being permanently coupled to the plant for immediate use.

On the basis of the results obtained in the pilot plant it has been agreed to proceed with the installation of a full-scale desulphurisation and sulphuric acid plant capable of dealing with the 32 mill. cu.ft. of coke-oven gas which will be produced daily in the Company's coke ovens by the end of 1958. The gases from the regenerator are particularly suitable for use in a contact sulphuric acid plant since they are dry and are free from arsenic, chlorides, and oxides of nitrogen. The quantity of sulphur gases available from such a plant should suffice for the production of more than 250 tons of sulphuric acid mono-hydrate per week.

## Steel Sulphurs

As described previously, the pilot plant was installed initially to cope with increasing sulphur in the steel due to increasing the use of crude coke-oven gas on the steel furnaces. This paper, therefore, would not be complete without a brief report on the effect of desulphurised gas on the steel sulphurs leaving R furnace, though a fuller report may be published elsewhere. The position is best summarised probably by a reference to Fig. 3, which illustrates the average sulphur removed weekly between charging and tapping (charge—pit sulphur) for R furnace and for the adjacent P furnace using crude coke-oven gas, over the period between the week ending September 29, 1956, and that ending January 5, 1957. For the first four weeks and the last three weeks of this 15-week period both furnaces were using crude coke-oven gas. For the intervening period, furnace R was using desulphurised gas, while P was using crude gas. It will be noted that except for the week ending November 3, 1956, the removal of sulphur from R furnace, when using desulphurised gas, has been substantially greater than from P, the reverse being true when R furnace was put back on to crude gas. The anomalous result for the week ending November 3 was probably due to operating troubles on R furnace which was in its final week before being taken off for roof repairs a few days later.

The overall improvement on R furnace sulphur removal using desulphurised gas over a long period has been estimated to be between 0.006% and 0.007% of sulphur. There has been a corresponding improvement of sulphurs in the slag but details of this need not be reported here.

The processes described in this paper are covered by British Patent Specification 719,056; other related patents are pending.

(*a*) An account is given of the chemical investigations leading to the development of a process for the desulphurisation of coke-oven gas, using a fluidised bed of hot iron oxide.

(*b*) A large pilot plant has been installed at Appleby capable of dealing with the maximum gas requirements of one of the large Appleby steel furnaces, amounting to about 2½ mill. cu.ft. per day. This pilot plant has been in operation since April, 1956.

## Regenerating Chamber

(*c*) Desulphurising is carried out in a fluidised bed of iron oxide at a temperature of about 350°C. The sulphided oxide is conveyed to a regenerating chamber where it is oxidised in a current of air at 600° to 800°C. The hot regenerated oxide is returned to the desulphurising vessel where it provides about one-third of the heat

requirements of the gas. The remaining heat is obtained by heat exchange of the cold incoming crude gas against the outgoing hot desulphurised gas in a suitable heat exchanger.

(*d*) The percentage desulphurisation originally averaged only about 70, but was raised to over 80 by the end of 1956, using a single bed of oxide. It has since been increased to a maximum of 98 by inserting a second shallow bed in the absorption vessel, while modifications of the pilot plant are in hand which it is expected will raise the degree of desulphurisation still further. The process also removes organic sulphur from the gas to a degree comparable with the $H_2S$ removal.

(*e*) An account is given of the method of operating the plant, and some if the operating problems encountered are discussed.

(*f*) A brief account is given of the influence of desulphurised gas on sulphur removal in the open-hearth furnace. It is shown that a reduction of about 0.007% in the pit sulphur can be expected as a result of using desulphurised gas.

(*g*) Plans are in hand at Appleby-Frodingham for the installation of a full-scale plant based on the same principle for the desulphurisation of 32 mill. cu.ft. of coke-oven gas per day, together with a dry contact plant for the manufacture of sulphuric acid from the regenerator gases.

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# SURVEY OF JAPAN'S GAS INDUSTRY

## *History Traced Back to 1872 in Tokyo Company's Publication*

A SURVEY of the gas industry in Japan to March, 1958, has been issued in English by the Tokyo Gas Company. There are now 107 gas undertakings of which 24 are municipally or 'corporation' owned, the remainder being owned by joint-stock companies. About 200 cities and towns are supplied with gas, but the six large cities, Tokyo, Yokohama, Kyolo, Osaka, Kobe, and Nagoya consume about 85% of the total supply. These cities are supplied with gas by the three big companies, the Tokyo, Osaka, and Toho Gas Companies. Some 76% of the town gas in Japan is coal gas, generally mixed with producer gas derived from coke. Increasing quantities of natural gas and oil-gas are being distributed.

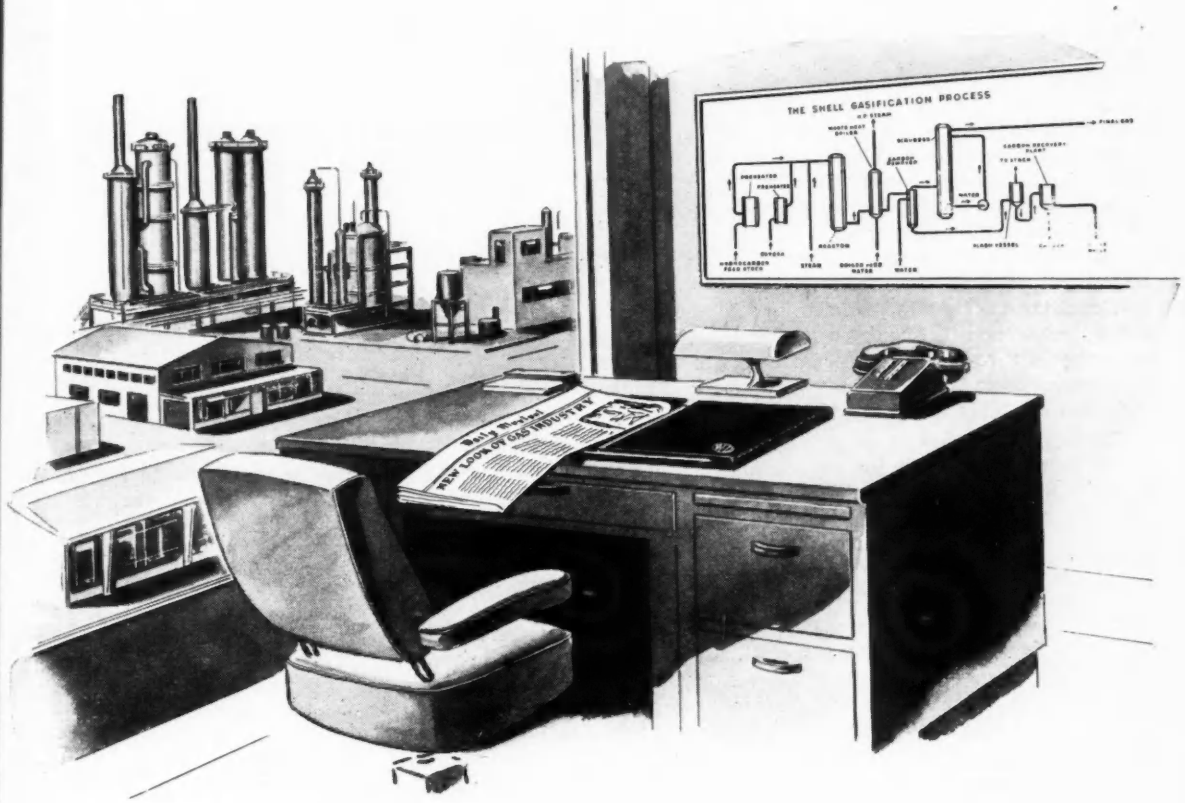
### Rapid Expansion

In a 'Short History of the Gas Industry in Japan' it is stated that the first public utility gas enterprise was established in Yokohama in 1872. The gas industry, recovering from the 1914-18 war, began to expand rapidly after 1920, particularly after 1924 when a Gas Undertaking's Law freed it from 'the fetters of municipal interference.' World War II produced in Japan, as in other belligerent countries, a tremendous demand for gas for industrial requirements, the whole demand reaching a peak in 1942. Government 'recommendations' led to much integration, many small undertakings being absorbed by larger neighbouring undertakings; in one region 120 undertakings were reduced to 75 in number.

War destruction and other incidental difficulties, however, reduced gas production to a 'trough' which by 1946 represented a coal consumption of only one quarter of that of the peak of 1942. Recovery, hampered by shortage of raw materials, was slow but steady. By 1953 it had again passed the 1942 gas consumption figure of about 46,000 mill. cu.ft., and a five-year extension plan was launched. 'The actual results at the end of 1957 showed that they somewhat surpassed the planned figures and the quantity of gas distributed amounted to 108,033 mill. cu.ft.

The gas industry now stands again on a sound foundation and gas consumption is increasing yearly 'by leaps and bounds.' The modern tendency to gas consumption is to a wider difference between summer and winter demands. In Japan, as elsewhere, recourse is had to oil-gas and complete gasification of coal to meet the winter peak loads, while in the last few years many c.w.g. plants have been installed, all the larger ones being designed to use heavy fuel oil for carburetting. 'The world's largest gas integrale coal water-gas plant was recently started in the new Toyosa works of the Tokyo Gas Company.'

For base loads the large works are 'invariably' equipped with coke-ovens of standard types with producers and often with coal-washing plants. Small and medium sized works use horizontal retorts or small chamber ovens. Producer gas made from small coke or nut coal is used both for firing coke-ovens and for diluting coal gas. Liquid purification is now in several works combined with oxide box purifiers. In some works elementary sulphur is recovered or sulphuric acid is made. Most of the large gasworks are equipped for tar distillation. Several spherical high-pressure gasholders have been installed with capacities ranging




# A new look is coming to the Gas Industry

Town gas still flows from the holders but the Works' skyline is changing and beginning to show the influence of Oil and High Pressure Processing. Woodall-Duckham's new High Pressure Processes Division has been formed to meet these changes and complete plants can be provided for the production of gases suitable for Town supply, etc. using modern high pressure techniques.

**WOODALL-DUCKHAM CONSTRUCTION COMPANY LTD**
WOODALL-DUCKHAM HOUSE, 63-77 BROMPTON RD., LONDON, S.W.3
Telephone: KENsington 6355 (14 lines) Telegrams: Retortical (Southkens) London

from 35,000 to 3,500,000 cu.ft. and pressures from 28 to 114 p.s.i.

Ordinary gas coals are used in the smaller works using horizontal retorts, but the larger works equipped with coke ovens use blends for the production of foundry coke and other high grade cokes. A typical blend for the manufacture of foundry coke is 50-60% indigenous high-volatile bituminous coals, 10-25% low or medium volatile coking coals (indigenous or imported), 20-35% anthracites (indigenous or imported). Pulverised petroleum coke (imported from the U.S.A.) and coal tar pitch are sometimes used in the blends for the production of foundry coke. Indigenous coals are sometimes re-washed at the gasworks to produce high grade cokes. The amount of coal imported in 1956 was 11.3% of the total coal carbonised.

The total production of coke in Japan in 1956 was 8,240,280 tons, of which the gas industry produced 52.9%. Almost all of the coke produced by the iron and chemical industries is used for their own processes. Of the total of 3,189,827 tons marketed 61.3% was sold by the gas industry. Natural gas sold was only 2% of the total supply in 1956.

Before the war, in the larger cities, the calorific value of town gas was about 440 B.t.u. per cu.ft. at 60°F. and 30 in. moist, but towards the end of the war the calorific value of gas from all undertakings (except those based on natural gas) was standardised at 376 B.t.u. per cu.ft. and this standard is still in force.

Gas consumers are classified into domestic industrial, commercial and 'others.' Their consumption in 1956 was 57.5%, 16.6%, 18.3%, and 7.6% respectively. The domestic use of gas is for cooking, water heating and space heating. Industrial gas is used over a wide range of industries. Commercial use covers restaurants, hotels, offices, schools, hospitals, etc.

The first five-year extension plan was completed in 1957 with very satisfactory results. Gas consumption increased by 70%. But 'Japan is still an underdeveloped country with respect to the gas industry.' Only 41% of the people within the gas supply area, or only 16% of the whole population, are enjoying the benefits of town gas. The second five-year plan of extensions anticipates a further increase of 60%—a gas consumption of 175,950 mill. cu.ft. in 1962.

## Growing Concentration

At the end of 1957 the number of consumers was about 3 mill. It is intended to extend both production and distribution equipment to serve a further 1½ mill. consumers. Such an expansion will be assisted by the growing concentration of population in urban areas. 'For instance, in 1950, the distribution of population in urban districts and country was 37.5% and 62.5% respectively—in 1955, it was reversed and became 56.3% and 43.7%.'

The estimated cost of this second stage of expansion is a sum equivalent to more than 50% of the present value of the gas industry's assets. About one half of this enormous sum (127.8 mill. yen) will be realised from internal sources such as depreciation and actual reserves; the remainder will be raised by the issue of new stock and bonds and by bank loans.

It is realised that the cost of gas production will be increased by growing capital costs and depreciation, but that the selling price of gas cannot be indefinitely increased in the face of the competition of oil and electricity. Costs must be kept from rising by a 'thorough rationalisation in all sections of production, distribution, sales promotion, and management.' With this in view it is proposed to make a thorough study of productivity methods in the American gas industry.

The Tokyo Gas Company was established in 1885. Its distribution area covers the Kanto area surrounding the great cities of Tokyo and Yokohama. At the end of 1957 its consumers numbered 1,257,000, and sales during the year were 1,399,257,850 cu. m. (say 49,400 mill. cu.ft.). During and since World War II the fluctuations of sales followed a pattern similar to that of the industry as a whole, with a peak in 1941, falling to a trough at 1946, followed by a rise even more rapid than that in the whole country, sales during 1957 showing an increase of 190% over those of the war-time peak.

## Spherical Holders

Tokyo's part in the five-year plan, 1953-1957, included the construction of an 800-ton coke oven plant at Senju, gasholders of 175,000 cu. m. (say 6 mill. cu.ft.) and 100,000 cu. m. (3½ mill. cu.ft.) capacity at Takinogawa and Hoya holder stations and two sets of high-pressure spherical holders at Setagaya. Two sets of 1,000-ton coke-ovens were constructed at Toyosu works on land reclaimed from Tokyo Bay, with the very large gas integrale complete gasification plant referred to above, high pressure purification plant and two high-pressure spherical gasholders each with a capacity of 100,000 cu. m. (say 3½ mill. cu.ft.).

In the second five-year plan, dating from the beginning of this year, it is proposed to increase the number of consumers by 44% and the sale of gas by 62%. For this purpose it is intended to install 14 oil-gas plants with capacities 100 k1-250 k2 (22,000-55,000 gal.) per day, and a further 1,000 ton coke oven plant is to be constructed in 1961. The total producing capacity in the last year of the plan is estimated to be 9,540,000 cu. m. (say 337 mill. cu.ft.) per day compared with that of 5,970,000 cu. m. in 1957, an increase of 60%.

The total quantity of gas made in 1957 was 49,175,964,000 cu.ft. at a declared value of 404 B.t.u. per cu.ft., 46.2% of the gas supplied by all the gas companies in Japan. The use of gas is distributed over 58.5% for domestic purposes, 17.7% commercial, 16.7% industrial, 7.1% public and other purposes.

Coke is sold by the Tokyo Coke Company, which was established in 1949 as the sole agent for the coke produced by the Tokyo Gas Company. Coke production for sale in 1957 was 1,211,717 metric tons mainly for industrial and manufacturing purposes.

Tar products are dealt with by another subsidiary company, the Kanto Tar Products Co., Ltd., sole agents for the Tokyo Gas Company, which claims to be the originator of this industry in Japan in 1901. The Kanto Company was established in December, 1948. Besides tar products, other by-products of the Tokyo Gas Company are marketed, such as sulphur, ammonium sulphate, and germanium.

# Report on the Removal from Gas of Organic Sulphur in Some Glass-making Processes

SEVERAL glass factories in the area of St. Helens, South Lancs, have installed their own activated carbon and catalytic sulphur extraction plants. The desirability of removing organic sulphur for some processes in that industry has prompted a study of the subject by Mr. R. L. Greaves General Manager, South Lancs Group, North Western Gas Board.

Mr. Greaves lays out a table (Table 1) showing the composition of typical organic sulphur contents in various gases.

TABLE 1.

| Type of gas | C.W.G. | Vertical gas | Horizontal and chamber gas | Intermittent verticals |
|---|---|---|---|---|
| | grains/cu. ft. | grains/cu. ft. | grains/cu. ft. | grains/cu. ft. |
| Total organic sulphur .. | 15 | 25 | 25 | 24 |
| $CS_2$ Carbon disulphide .. | 1 | 10 | 11 | 10 |
| $C_4H_4S$ Thiophene .. .. | Nil | 5 | 8 | 6 |
| COS Carbon oxy-sulphide .. | 14 | 10 | 6 | 8 |
| Mercaptans .. .. .. | Trace | Trace | Trace | Trace |

These substances may be removed to a greater or smaller extent by catalytic processes which make use of various active agents but all carbonisation gases and especially water gas contain nitrogenous gums which tend to foul the catalyst used if the temperature is below 200°C. At the temperature used by both the Maxted catalytic process, *i.e.*, metallic thiomolybdates, and the North Thames Gas Board's catalytic process, all the gum is destroyed. The use of activated carbon removes all thiophene, all $CS_2$ but little COS and results in 10 grains per 100 cu.ft. remaining in the gas. The catalytic process using nickel molybdates readily removes 85% COS, 85% $CS_2$ and 20% $C_4H_4S$ to give a gas containing only 4.5 grains per 100 cu.ft. Although benzole extraction with high oil circulation reduces the organic sulphur content, it is not discussed here.

## Activated Carbon Plants

At St. Helens, vertical retort gas mixed with about 20% C.W.G. is received by various glass works, after some of the thiophene has been removed by benzole extraction. For some of the glass works' processes organic sulphur removal has proved desirable and practice varies between partial removal with activated carbon and almost complete removal with activated carbon, followed by the catalytic process at the works concerned; usually only on such part of the gas flow as is to be used for special processes. Activated carbon plants have been in use at one glass works for 20 years and the first industrial Maxted catalytic plant was also installed, at a St. Helens glass works, many years ago.

The price of these plants of different capacities is shown in Table 2.

The 10,000 cu.ft. per hour plant is the largest unit which can be purchased in a packaged style, *i.e.*, ready

TABLE 2.

| Capacity | Price |
|---|---|
| Cu. ft. per hr. | £ |
| 40,000 | 21,000 |
| 30,000 | 16,000 |
| 20,000 | 12,500 |
| 10,000 | 6,500 |

for delivery in one portable unit. This indicates that there may be cases in which capacities are as great as 20,000 or 30,000 cu.ft. per hour, and it may be desirable, where operating practice and markets vary, to install two or three package size plants rather than one fixed plant. A firm of glass manufacturers at Ravenhead and Sherdley, St. Helens, have about 10 package size plants operating on gas steams after organic sulphur has been removed to the limit by activated carbon, thus further reducing organic sulphur to an absolute minimum. Another firm has several activated carbon plants bringing the organic sulphur content to 10 grains per 100 cu.ft.

The capital cost of plants is calculated to be approximately 40% of the total cost; though operating costs vary considerably. Priestley quoted the total cost of sulphur removal by the Holmes-Maxted plant at Mirfield as ½d. per therm in November, 1957. If a catalytic plant, however, operates at half load the total cost is approximately ¾d. per therm today. If it operates at full load the total cost is approximately ½d. per therm; this includes capital, heat for the process, and oxide purification to remove the $H_2S$ generated by the hydrogenation.

Activated carbon plants also remove benzole which at St. Helens is purchased back by the gas undertaking. The price received on the sale of the benzole and credited to the industrial consumer largely pays for the loss in calorific value due to the removal of benzole at the consumers' works. This loss in calorific value is roughly 25 B.t.u., which for a gas of C.V. of 450 B.t.u. per cu.ft. is 5.5%. For an activated carbon plant there must be available a supply of steam which is an important factor. The removal of organic sulphur to 2 grains per 100 cu.ft. by using the two processes, namely, activated carbon followed by catalytic removal, doubles the capital cost as against the single catalytic process for partial removal at 4.5 grains per 100 cu.ft. With a catalytic plant at a gasworks careful retort house operation is necessary to avoid high oxygen contents in the gas to be treated. High oxygen contents of gas saves heat required on the external heating unit but if the oxygen is excessive the degree of heat exchange would have to be cut down to avoid high catalyst temperatures. The limit to efficient operation solely on a catalytic plant is around 4.5 grains per 100 cu.ft., although it is possible to achieve 3.5 grains per 100 cu.ft.

if great care is taken. However, where 3.5 grains per 100 cu.ft. has been achieved deterioration over a period was 3.5, 3.7, and 4.5 grains per 100 cu.ft.

Although up till now activated carbon plants have normally preceded catalytic plants in the gas stream at industrial works, this position may with advantage be reversed at the gasworks since the benzole thus produced would contain less sulphur. This point is well worth consideration and was practised at Mirfield. It would not originally have been possible to reverse the position in the industrial cases mentioned because greater volumes of gas were used in the activated carbon streams and only small volumes in the first catalytic streams.

# Liability for Danger after Removal of Public Services

*By T. J. SOPHIAN*

AN important decision affecting electricity and gas boards and similar authorities providing services, and also contractors, has been given by the House of Lords in Miller *v.* The South of Scotland Electricity Board.

In that case a house, the property of a local authority, was to be demolished. When it became vacant the Borough Surveyor notified the Electricity Board so that they might disconnect their services. On December 20, 1954, the Board notified the local authority that this had been done. The Board had removed the meter, withdrawn the fuses, and sealed off the cut-outs.

The authority had then proceeded with the demolition, but the building was in a partially demolished state and without a door, when on April 7, 1955, some four months after the removal of the services, a boy entered the house. In the interval apparently some person unknown had entered and wrenched the electric cable from the sealing chamber. This cable was lying on the floor, having on it a length of bare wire which carried current. The boy, who was apparently trespassing, touched the wire and was injured.

In these circumstances, the question arose whether there could be any liability on the Board for the accident. The Scottish courts, before whom the case, brought on behalf of the boy against the Board, came up for hearing, held that no case for liability was made out on those facts, and they in effect dismissed the action.

The House of Lords, however, on appeal, held that a *prima facie* case had been made out to entitle the case to be tried, when all the evidence could be put before the court, and the question of legal liability could then be decided by applying the principles of law to the facts as fully ascertained.

Among the questions that would have to be determined for this purpose would be whether the event could have reasonably been foreseen by the Board; whether the Board had informed the local authority precisely what had been done by way of 'disconnection' of the services; whether there was any difference between a request to remove services, and a request to remove services *completely;* and why *live* electric wiring should be left in a house about to be demolished. Technical explanations, moreover, would have to be given of the operations of the Board in disconnecting the services, and of the subsequent state of the wiring and its liability to be interfered with by strangers or unauthorised persons.

It is interesting to observe that in this case, the local authority who owned and occupied the building were not sued, the reason for this perhaps being that, an occupier does not owe the common duty of care to a trespasser, and that on the facts, it would have been necessary to establish that the boy was lawfully on the building.

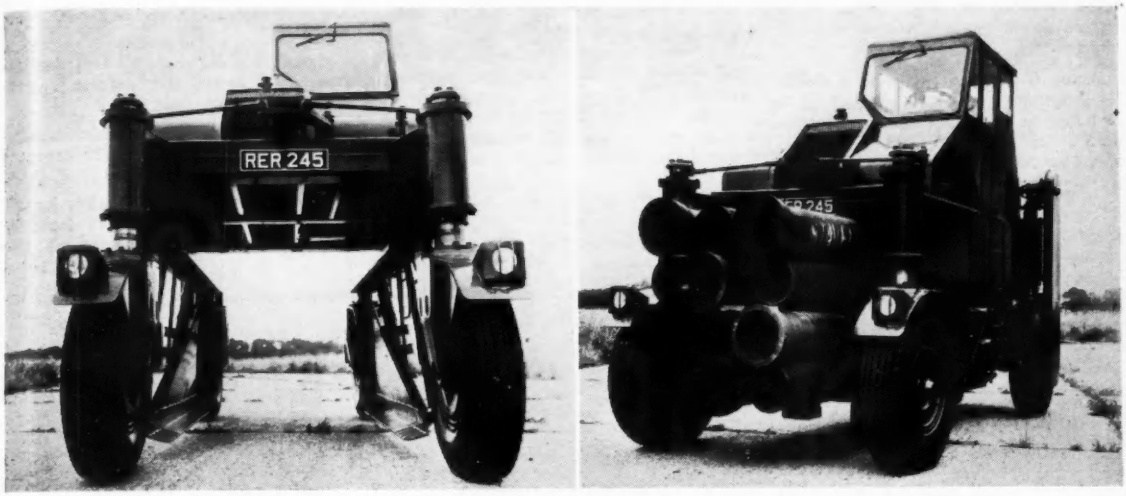
While an occupier may not be liable for damage suffered by trespassers as the result of dangers on the property, it would appear from a consideration of the Judgments of the House of Lords in the above case, that the liability of *persons doing work or anything else on the land,* stands on a different footing.

Such a person, whether he is an *occupier,* or *contractor,* or *anyone else,* owes a duty to all persons who are so closely and directly affected by his work that he ought reasonably to have them in contemplation when he was directing his mind to the task. While no one would suggest that he ought to have a burglar in contemplation, he ought to have *children* in contemplation if he knew they were in the vicinity or were likely then or later to be attracted to the spot.

In the words of Lord Denning, 'It did not avail him to say "they were trespassers" and wash his hands of all responsibility. . . . He must bother about them if he knew or ought to know that they were likely to be affected by what he was doing; he must take reasonable care to prevent injury to them.'

It is interesting to observe in conclusion that the Lower Court had taken the view that, if there was any liability, it was the liability of the local authority, who were the owners and occupiers of this building, and not that of the Electricity Board; for the Board had left the building in a condition which was safe as long as it was securely locked, but the local authority had later left the building open, without notifying the Board who therefore may have taken additional safety measures. There had thus been in the view of the Lower Court a break in the chain of causation.

This line of approach, however, did not find favour with the House of Lords. There was a *prima facie* case of negligence against the Board, and the claim was not to be defeated by the fact that subsequently someone else may also have happened to be negligent. The case accordingly was directed to be tried.




**Left:** *Front view of the British Straddle Carrier Mark II, showing the self-aligning lifting hooks, which are hydraulically operated and controlled by the driver.* **Right:** *A load of pipes in position.*

# *The Straddle Carrier—Top Speed 30 m.p.h. —Takes Maximum Load of 20,000 lb.*

THE 'British Straddle Carrier Mark 2'—the first vehicle of its type designed to comply with the 'Construction and Use' Regulations of the Ministry of Transport, which permit its use on public roads—is built by the British Straddle Carrier Co., Ltd., which, as recently announced, is now a subsidiary of Short Bros. & Harland Ltd.

The carrier is being produced under the control of Short's General Engineering Division at Newtownards, Co. Down. It was demonstrated last week for the first time to interested trades, public authorities, and government departments.

The carrier is said to provide 'the fastest and cheapest available method of handling and transporting freight.' At the demonstration the carrier took on a variety of timber loads, including telegraph poles, and lifted and transported loads of oil drums, barrels, bricks, crates and pipes and similar freight.

### Costs Reduced

One man only is needed to pick up and transport loads by straddle carrier. This means that handling costs are substantially reduced, and ancillary manned equipment, normally needed at loading and discharge points, is released for other work. The vehicle carries its load lengthwise, and an important consequent advantage is that it needs only bare clearance for its overall width. Thus it can operate at speed in narrow gangways or in lanes closed to vehicles which lift their loads crosswise.

As its name suggests, the carrier simply straddles the load, which is mechanically lifted and clamped *below* the superstructure with the weight evenly distributed over the four wheels. Under the control of the driver only, the vehicle picks up a load in a matter of seconds, transports it, sets it down, and returns for another load.

The vehicle has capacity of 20,000 lb. and transports varying loads at speeds ranging up to 30 m.p.h. Loads 40 ft. long are undertaken as an every day task but the straddle carrier is capable of carrying freight of very much greater length and has, in fact, successfully been used to carry loads as long as 100 ft.

With the usual system of operation, loads are stored and handled on bolsters of wood or steel or, alternatively, on pallets. The carrier drives endwise over the load and the ledges of its self-aligning lifting hooks clamp under the bolsters or pallets. The driver manipulates simple controls which operate the lifting mechanism, the load is raised and clamped in the transporting position under the superstructure, and the carrier drives off. At destination the operation is reversed, and the carrier returns for more freight.

The British Straddle Carrier is particularly effective on rough terrain. It has large diameter wheels which exert immense tractive effort and enable it to travel swiftly over ground so rough that the use of other types of equipment and vehicles is impossible.

In tests the British Straddle Carrier has picked up a load of 20,000 lb., carried it 220 yards, set it down, and returned unladen to the starting point —all within two minutes.

### Increasingly Used

Although the British Straddle Carrier Mark 2 is the only straddle carrier produced in Britain, this system of freight handling and transport is being increasingly used throughout the world.

The design features are as follows:—

*Carrying Capacity:* A maximum load of 20,000 lb. can be transported at 12 m.p.h. Carrying 14,000 lb., the Carrier can travel at 30 m.p.h.

*Swinging Lifting Hooks:* The hooks clamp and lift hydraulically, aligning themselves automatically with the load. A relief valve provides overload protection.

*Powered Steering:* The Carrier is fitted with a Marles integral power-assisted steering unit. Pressure builds up only to the extent necessary to provide the steering effort needed. The power assistance gives effortless steering. The geometry of the steering linkage reduces tyre wear to a minimum.

*Four-wheel Steering:* All four wheels are steerable, giving maximum manœuvrability in yards and confined spaces. For use on the highway, where two-wheel steering is mandatory, the rear wheels are locked by a patented

## Trade News

device and normal commercial vehicle manœuvrability is achieved on the front wheels only.

*Power Unit:* The engine is a Perkins L.4 industrial type 4-stroke diesel, giving 62 b.h.p. at 2,000 r.p.m., and has been chosen for its ample power combined with low fuel consumption.

*Differential Unit:* The Eaton 2-speed differential is an effective solution to the problem of operation at maximum efficiency and economy under the differing load conditions in service.

*Flexible Hydraulic Lines:* Synthetic rubber oil-resistant hose lines are used throughout the system, giving flexibility which is a particular advantage during servicing, and eliminates fatigue failures sometimes encountered with rigid pipework.

*Construction:* The chassis is robustly constructed and has been proved by testing over a long period on a special test-ground and in timber-yard operation.

*Gearbox:* Six speeds are available both in forward and reverse and all are selected by one lever.

*Wheels:* Readily available standard tyres, of commercial vehicle type, are fitted.

*Brake:* Power-assisted brakes increase safety and need little effort from the driver.

# PARKINSON COWAN'S 'NEW LOOK' COOKER—THE PRINCE

THE success of the Parkinson Cowan Renown Six helped to prove that there is a ready market for a medium priced, high grade cooker. With their latest cooker—the Prince—Parkinson Cowan have introduced a useful addition to this range. At 39 guineas the Prince offers self-lighting boiling burners, a large storage drawer, capacious drop-door oven, and an interesting combination of short splash-plate and high level grill and platerack. We publish below specially prepared details:—

The high level grill is a fixed unit with a single burner. All grill components —top cover, grill cover, frets and cast iron burner are easily removed for cleaning and servicing.

### Plate Positions

The open wire platerack carries the grill pan and provides six plate positions, each one of which takes two plates.

Both upper and lower splash-plate are readily removed for cleaning or servicing.

The four burners have slotted ports and are pressure die cast in an aluminium alloy.

The hotplate tray carries the large pan supports which give glide over pan stability. Pan supports are reversible and interchangeable; the hotplate is reversible. The hotplate well covers all tap bodies, governor, thermostat and pipework, and it is removable for servicing.

The four boiling burners are self lighting. The ignition is provided through flash tubes radiating from a single central pilot with tap control.

A gas torch included in the price of the cooker is used for lighting the grill and the oven.

A flash tube carries ignition from the lighting port at the oven front to the centre of the oven burner.

Grill burner aeration is by adjustable shutter with locking device. There are cadmium plated steel aeration screws and locknuts in the boiling burner throats; no adjustment is necessary to the oven.

All burners—grill, four boiling burners and the oven burner, are rated at 12,000 B.t.u. (24 cu.ft. an hour on 500 c.v.).

The oven has embossed sides and a single back burner.

### Safety Shelves

The non-tip safety shelves which are made in bright chromium plated steel cannot be pulled out accidentally or replaced incorrectly.

The drop oven door has no latch. The oven door sealing is provided by the wedge platform on the inner door panel fitting against the flexible stainless steel strips around the oven front.

### Counterbalanced

The door is counterbalanced by springs attached to the quadrants and pivots on two door hinge pins.

The rod type thermostat combines the oven tap and oven heat control. The settings are ¼ to 12—with an extra 'low' setting. The low setting allows only gas passing through the thermostat bypass to reach the oven. This gives a minimum heat, well below the average quarter setting.

The storage drawer runs on nylon wheels and is removable. The gas connection is ½ in. B.S.P. at back left hand of cooker. Provision is made for a recess fitting. The governor is of die cast aluminium 150 DA buttonless.

Finished in exterior enamels of white or cream, the fascia panel, oven door handle and storage drawer handle, are in cream, white, red, green or blue.

Coloured components are easily changed. The fascia panel is held by easily accessible screws; the handles are held by screws which can be removed from the front of the handle.

### Dimensions

Height (overall) 56 in.
Width (overall), 21¼ in.; 22¼ in. (including lighter elbow).
Depth (overall), 23½ in. (including handles).
Height to hotplate, 36 in. (including pan supports).
Height to gas inlet, 32 5/16 in. centre line.
Hotplate—width, 21¼ in.
Hotplate—depth, 18 in.
Height hotplate to bottom grill pan, 13⅛ in.
Weight—complete, 171 lb.

### Oven Dimensions

Cooking space (B.S.) height, 15 in.
Cooking space (B.S.) width, 13½ in.
Cooking space (B.S.) depth, 10½ in.
Cooking space (B.S.) volume, 1.23 cu.ft.
Door opening, 18 in. × 15 in.

### Storage Drawer

Height 4¼ in.
Headroom 6 in.
Width 16¼ in.
Depth 17½ in.